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SURFACE MODIFICATION OF SILK FABRIC USING PLASMA TREATMENT

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ABSTRACT

The plasma treatment is a dry process that is done by gas; it creates significant surface modification in textile material without water pollution. Silk is a strongest natural fiber and widely used in both apparel and technical textiles application. In this study, the selected silk fabric was treated to oxygen plasma at low frequency for ten minutes. Then the physical properties of the plasma treated and untreated samples were investigated. The effect of plasma treatment was examined by visual inspection. Based on results, the plasma treatment increases the luster and absorbency of silk fabric.

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KEY WORDS: plasma treatment, silk fabric, physical properties, absorbency.

1. INTRODUCTION

'Sustainable', 'reasonable' and 'nature friendly' production is an important issue in textile manufacturing processes. Plasma treatment used in order for modification on the surface of textile material is one of the ecological and economical methods. silk the queen of textiles is distinguished for luxury, elegance and comfort.silk is produced by the silkworm bombyx mori; it is the only organic fiber that is in the form of filament Gowda.(2006). Silk has been defined as "smooth, lustrous, elastic fiber of small diameter and of animal origin". Silk is a structure less secretion in the form of a cocoon consisting of continuous filament. It is a smooth, lustrous, elastic and fine filament, the length of which varies from cocoon to cocoon and from species to species expresses Mishra (2000). Plasma is a Greek origin word meaning 'collective'. It can exist over an extremely wide range of temperature and pressure, some scientist has dubbed plasma as "the fourth state of matter", because the plasma is neither gas nor liquid, its properties are similar to those of both gases and liquids plasma can be defined as a partially or wholly ionized gas with a roughly equal of positive or negative charged particles in enticed states, radicals, metastables and vacuum ultra violet radiation Rani (2007).,

2. MATERIALS AND METHODS

2.1Materials

Silk is the strongest natural fibre at 2.6 to 4.8 grams per denier. Four meters of mulberry silk fabric was purchased for this study.

Pretreatment of silk fabric

Removing sericin from the selected fabric was done using by optimal degumming process. The detergent solution contains 0.5ml per l00ml of water was prepared. It was heated to 500C. Silk fabric was dipped into this solution and stirred gently for about 30 minutes. It was squeezed in the soup solution and then rinsed under tap water till free from traces of detergent. After that, fabric partially dried and ironed.

2.2 Selection of plasma treatment on silk fabric

Plasma is defined as a partially or wholly ionized gas with equal number of positively and negatively charged particles. In any piece of material if energy is supplied continuously, the temperature of the material increases and it passes from liquid state to the gaseous state. This mixture is referred to as plasma and is often called the fourth state of matter. The plasma can also be created artificially by exposing the gases such as oxygen to high frequency electrode magnetic fields in a vacuum chamber and causing them to discharge (Sudha, 2006).. According to Bhat (2007), when a fabric is immersed in the plasma it gets bombarded by ions/electrons resulting in profound modifications of the surface. Depending on the conditions, the fabric gets cleaned (removal of contaminants), etched (removal of material), activated (enhancement of surface energy) or coated (deposition of thin film). It is thin capability to control the conditions of plasma that gives the tremendous processing power which makes the plasma processing and appealing tool

2.2 Procedure for plasma treatment

50cm length and 45cm width of degummed silk fabric of used for plasma treatment. The mechanism used in plasma treatment by glow discharge method. In this study atmospheric pressure plasma reactor was used. Plasma chamber is having acrylic sheet was inside chamber and it is transparent to light. The gap between the two glass plates two millimeters to start the plasma discharge under oxygen gas zone which is working on the principle of glow discharge method. The power needs to generate plasma depends on the size of the electrodes and gap between the electrodes. The application of plasma in the presence of oxygen gas in this chamber the plasma chamber is operating in the flow of oxygen in the rate of 0.15 SLPM (Standard Liter per Minute) and RF (Radio Frequency) discharge was varied between 500w and 600w for 4to 7 minutes.

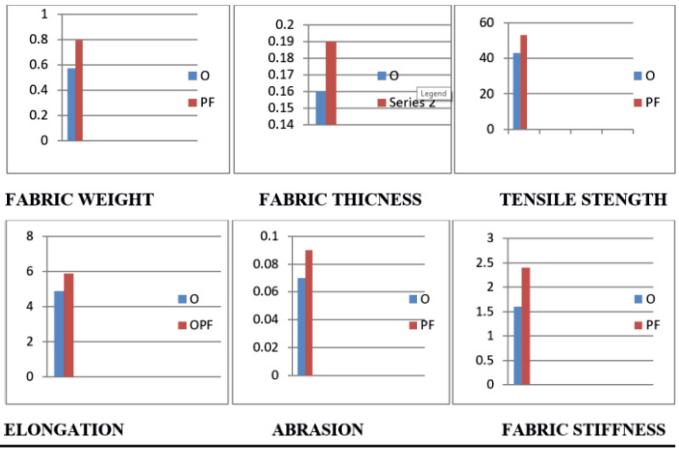
4. RESULTS AND DISCUSSION

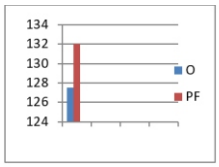
TABLE - I
Evaluation of physical properties Properties Original PF

Properties	Original			PF		
	Mean	Gain / loss	% of Gain / loss	Mean	Gain / loss	% of Gain / loss
Fabric weight (grams)	0.57			0.79	0.22	23.7
Fabric thickness (mm)	0.16			0.19	0.3	21.4
Tensile strength (Kg)	43			53	10	23
Elongation (cm)	4.9			5.9	1.06	20
Abrasion (grams)	0.07			0.09	0.02	12.5
Stiffness (cm)	1.6			2.4	-0.77	45.8
Crease recovery(˚)	127.5			132	5.2	4

ORIGINAL - Control sample, PF - plasma treated sample,

FIGURE-I





CRESE RECOVERY

ORIGINAL - Control sample, PF - plasma treated sample,
Fabric weight of the samples was evaluated, from the results maximum gain in weight was found in plasma treated sample (PF) when compare with original. The plasma treated sample (PF), had significant improvement in thickness from its control sample. In the physical properties test, best results was obtained in sample PF because of plasma treatment.

The strength and elongation of the fabrics were evaluated by Tensile strength tester. Higher the reading indicates more in strength and elongation. On comparing with original sample PF shows higher results in warp and weft direction. It proves that plama treatment improved the tensile strength and elongation of the fabric.

The abrasion resistance of the samples was evaluated by Martindale abrasion tester. The best result was found in plama treated sample . Stiffness test was performed in the Shirley stiffness tester. The significant gain in stiffness was observed in all the finished fabric. Thus the finishing treatment improved the stiffness of the fabric.

Crease recovery of the samples was measured by Eureka crease recovery tester. Least value of crease recovery indicates higher in crease recovery, from the results the highest crease recovery was seen in plasma treated sample when compare its control sample along both warp and weft direction.

The drape co-efficient of samples was analyzed by drape meter. The result shows that all the finished samples were decreased in drape co-efficient, because the `finishes improved the stiffness of the fabric.

The absorbency of samples was evaluated by drop test, sinking test, capillary rise test. All the treated samples have significant improvement in absorbency, but the maximum level of absorbency was found in plasma treated sample. From the objective evaluation, it can be concluded that plama treated sample shows the best result when compare with its control sample.

5. CONCLUSION

Plasma is a exclusive method which is having several species like electrons, ions, radicals,. Any material exposed to plasma gets modification. Surface properties can be modified in beneficial ways by properly choosing plasma parameters. The physical properties of silk fabric were analyzed in this study. The plasma treated sample shows better results in all the physical mechanical and comfort properties. The absorbency of the fabric is increased by the plasma treatment. The maximum lustrous is achieved in the silk fabric by plasma treatment.

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